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showing an agreement of about 0.5 part per million.

The Colorimetric Estimation of Phosphates; Second Method: OSWALD SCHREINER and B. E. BROWN.

The first method previously described requires the precipitation of the phosphorus as the well known yellow molybdate containing phosphorus and ammonia. In this second method the phosphorus is precipitated with magnesia solution, washed with ammonia, dissolved in nitric acid, and read in the colorimeter after addition of molybdate.

Determination of Sulphur and Phosphorus in Food, Fæces and Urine: J. A. LE CLERC and W. L. DUBOIS. (By title.)

Device for Reading 'Nesslerized' Ammonia Tubes in Water Analysis: W. P. MASON. (By title.)

A Peculiar Occurrence of Bitumen and Evidence as to its Origin: WILLIAM CONGER MORGAN. (By title.)

AUSTIN M. PATTERSON.

MATERIAL VERSUS INTELLECTUAL DEVELOPMENT OF OUR UNIVERSITIES.

THE material development of our universities within the past two decades may safely be characterized as phenomenal, and has been more than commensurate with that of the country at large.

As a result the plain inexpensive college buildings of the past now stand by the side of palaces of to-day, while stately gateways and imposing walls flank the carefully graded grounds that once constituted the relatively unkempt campus.

Public taste is being awakened and directed to an appreciation of the beautiful. But apart from the esthetic side the equipment of scientific laboratories and the development of college libraries and museums have been distinguishing features in the recent growth of our institutions of higher learning.

The surroundings of the student are now far more hygienic than in the past, and things once regarded as luxuries are now rightly considered necessities of life. As an evidence of this we need only quote the following from a recent annual report of the president of Harvard University: "The practise of fifty years ago at Harvard College in respect to ventilation would now be against the law, * * * and public opinion would not now endorse the complete absence of bath-rooms from the dormitories owned by the college, an absence which occasioned very little remark down to the year 1890."

But lest we praise too unstintingly this unparalleled progress of the past twenty years, we should seriously consider whether the intellectual welfare of our universities is developing in even measure with their material progress.

The beauty of college grounds and stately buildings can not of itself elevate public taste, nor can extensively equipped laboratories turn out great workers in the fields of science. Too often, indeed, these things stultify through the very sense of satisfaction they engender in our minds. A wooden shed at Penikese was a sufficient opportunity for an Agassiz, and the dull routine of a colliery was but an incentive to the inventive mind of a Stephenson.

The age demands strong men and we must learn to respect our colleges not for their wealth in material things, but for having been the cradle and the home of leaders of thought and action.

A study of the reports of the commissioner of education and of announcements of college presidents and other officers may throw some interesting light upon certain phases of the intellectual and material progress of our colleges. Certain features, such as the increase in the number of students, the growth of libraries, the increase in the faculties and the development of the

post-graduate schools, may, if taken together and closely analyzed, be considered to provide a fair index of the intellectual growth of our colleges.

On the other hand, the increase in total value of the property, the increase in endowment funds, annual cost of buildings and the amounts of benefactions and appropriations for college buildings and grounds may contribute more or less directly to intellectual growth, but are not necessarily indicative of such development.

The fact is that the material progress of our colleges has in the past twenty years outstripped the *intellectual*, and while they have unquestionably grown as centers of learning, growth in *material* wealth has been the great distinguishing feature of their progress.

For example, we find that in the year 1902 there were 1.53 times as many colleges and universities in the United States as there were in 1890. During the same period, however, the number of students increased 1.9 times, or in even greater ratio than the number of colleges. This certainly is indicative of a growing desire, or a better ability, to take advantage of a college education, and yet the total number of students in 1902 was but 107,391, or less than one seven-hundredth of our population.

The student of 1902 found twice as many teachers in the colleges as compared with his predecessor of 1890, but as the number of students had also doubled, the classes under each teacher were on the average as large as were those of 1890. It appears that our colleges, as a whole, have not been able to increase the teaching force in greater ratio than the growth of the student body, although it has long been recognized that small classes, or divisions, are necessary in order to secure the paramount advantage to the student of a close personal relation with his teacher.

Our most progressive universities have, however, striven earnestly to attain this end, but have been able to achieve it only by appointing a large number of young instructors and assistants at small salaries. Indeed, the average salary paid to members of the faculty in our leading eastern universities has declined steadily. At the same time the percentage of instructors, assistants and other subordinates serving upon the teaching force has risen.

In other words, the teaching is now performed more largely by young and poorly paid men. Albeit, however, young as they be, they are men the average of whose ability is high.

The case of two of our greatest eastern universities is typical of the general situation: In one of these in 1889-90, 39 per cent. of the teaching force were professors or assistant professors, and the average salary was \$1,500; in 1892-03, however, the number of professors and assistant professors had decreased to 28 per cent. of the total number of teachers, while the average salary had declined to \$1,257.

In another great institution in the New England states, 49 per cent. of the teachers were professors or assistant professors in 1890, and the average salary was \$1,454; while in 1902-03, only 37 per cent. of the faculty were professors and the average salary was about \$1,355.

Promotion within the faculty of these great institutions has become so slow that it may be not inaptly compared with this condition within the United States Navy between the years 1868-98, when gray-haired lieutenants were the rule. The years of struggle have been lengthened for the aspirant to collegiate position, and college teachers of marked ability are now ordinarily men of middle age before being promoted to an assistant professorship.

This condition of affairs can not fail but to react unfavorably upon the universities

themselves, for the best young men of our land must realize all too fully that effort and ability sufficient to win high honor in the professions, or in business affairs, will avail but little if exerted within the college walls, and that for many years they and their families must live upon less than is earned by railway conductors, or baggage inspectors in the custom house.

It is, indeed, an open question at the present day whether the members of our greatest faculties compare favorably in judgment, or even in character, with leaders in law, medicine or affairs. Too often one feels that the narrowing influence produced by years of poverty has had its final effect upon the minds of many of our best scholars. Unless conditions be changed the faculties of our universities must surely deteriorate, and the cause of education will suffer incomparably; and is now suffering to a greater degree than even the intelligent public realize.

A certain lack of public respect for our great scholars is another but closely related factor that operates against the true interests of education. The names of Whitney, Gray, Leidy and Peirce have an unfamiliar sound to us in comparison with those of Max Müller, Sir Joseph Hooker, Sir Richard Owen and Sir George Airy, their foreign contemporaries of no greater worth.

It is true that the hope of being able to advance the good of the world should be a sufficient incentive to our effort; but men are not abstractions of philosophy, and grievously underpaid and unhonored professions will fail to enlist the interest of our ablest youth.

But to consider another phase of the intellectual growth of our colleges; one of the most recent as well as the most hopeful is the development of post-graduate schools by all of our leading universities. It is here, and here only, that advanced and productive scholarship appears among the stu-

dent body. The love and ambition for research is fostered here, and comparison between our universities and those of Germany can only be instituted with reference to our post-graduate schools, for only in this direction of progress do we approach the German standard.

Yet in 1902-03 the graduate students were but 4.6 per cent. of our student body, and if the graduate schools increase at the rate at which they have developed since 1890, more than a century must elapse before one half of the students in our universities will be in the graduate school. No great progress can be expected until the colleges can afford to appoint leaders of thought to professorships, the duties of which shall be confined to the graduate school. It seems, indeed, remarkable that this has not been done, for we have long since recognized that a primary condition of successful management demands that special faculties shall preside over the affairs of our medical, law, technical and other schools under the auspices of universities. Why should our graduate schools be without a special faculty? The work of the graduate school centers upon research, and it is, indeed, significant that the greatest encouragement ever given to research in pure science has come not from our colleges, but from one whose unparalleled success was achieved through the practical application of principles of science to industrial effort.

There is yet another standard by which we may measure the intellectual growth of our colleges. Their libraries in 1902 contained 2.1 times as many volumes as in 1890. Public libraries not connected with colleges, however, achieved the same increase in the same interval.

We now approach the consideration of the growth of our colleges in material things between 1889-90 and 1902, and the

TABLE SHOWING THE MATERIAL AND THE 'INTELLECTUAL' RESOURCES OF UNIVERSITIES AND COLLEGES OF THE UNITED STATES IN 1902; AND THEIR INCREASE SINCE 1889-1890.

Material Resources, 1902.	Amount.	Ratio of Increase Since 1889-'90.	'Intellectual' Status, 1902.	Total Number.	Ratio of Increase Since 1889-'90.
Total value of property.	\$417,205,234	2.8 $\bar{3}$	Number of universities and colleges.	638	1.53
Value of grounds and buildings.	154,529,288	2.4	Number of students.	107,391	1.9
Endowment funds.	185,944,668	2.5	Post-graduate students.	4,942	2.47
Benefactions received during the year 1902.	17,039,967	2.8	Number of teachers.	15,945	2
Appropriation received from states, cities, etc.	6,437,493	4.5	Number of books and libraries.	8,784,307	2.1
Cost of buildings erected during the year 1902.	5,680,000 at least	2.8 at least			
Income exclusive of benefactions.	33,863,244	3.3			

result of our studies may be summarized in the accompanying table.

Inspection of this table will reveal the fact that in the interval between 1889-90 and 1902 the material resources of our colleges have become from 2.4 to 4.5 times as great as at the beginning of this period, while their 'intellectual' resources, measured by the increase in schools, students, teachers and books, have become only from 1.53 to 2.47 times as great as in 1890.

The progress of our colleges in the past twelve years has been material rather than intellectual.

It is not the purpose of this article altogether to decry this progress, for many conditions have rendered it for the time, at least, desirable or even necessary, but it must be checked ere long and the *intellectual* side, the soul of the college, developed in greater ratio.

College presidents and boards of trustees must realize that imposing buildings and expensively equipped laboratories will not make universities. I grant that in our country it is usually far easier to gather funds for the erection of buildings than for the development of unseen things, but this fact alone should be a stimulus to those to whom the destiny of our colleges is entrusted to seek even more ardently for

aid in the adequate endowment of professorships, for funds required in the prosecution and publication of research, for the enlargement of learned libraries, and for all things pertaining to the intellectual life of the college. Men who give of their wealth to aid our colleges are usually actuated by unselfish motives, and would gratefully receive the advice of those in control of the destiny of education, to advance the highest even if unseen, rather than to create the spectacular and superficial.

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SCIENTIFIC BOOKS.

The Vegetable Alkaloids. With particular reference to their chemical constitution. By Dr. AMÉ PICTET, Professor in the University of Geneva. From the second French edition. Rendered into English, revised and enlarged, with the author's sanction, by H. C. BIDDLE, Ph.D., Instructor in the University of California. New York, John Wiley & Sons; London, Chapman & Hall, Limited. 1904. 8vo. Pp. vii + 505. Cloth, \$5.00.

The publication of the classical work on 'Die Pflanzenstoffe' by Dr. August Huse-